# **Examples of integration of learning objectives and assessments in mechanical ventilation education**

We present here examples of educational objectives and assessments as applied to mechanical ventilation. These examples have not been tested or validated, and are provided as examples for programs intending to do simulation-based mechanical ventilation education.

## **Cognitive Objectives**

### 1. Interpretation of Respiratory Loads

**Assessment Example: Clinical Case Scenario Analysis**

* **Description**: Present learners with a series of patient case scenarios that include varying respiratory conditions characterized by different elastic and obstructive loads.
* **Simulation Setup:** A ventilator connected to a test lung or adjustable test lung to simulate different respiratory mechanics, or a software-based simulator or a slide show with different simulated or patient ventilator waveforms.
* **Assessment Task**:
  + **Identify** the type of respiratory load present in each case based on provided data (e.g., patient history, lung mechanics, ventilator waveforms).
  + **Adjust Ventilator Settings**: Recommend appropriate ventilator adjustments to optimize patient care.
  + **Justify Decisions**: Provide a rationale for each adjustment, referencing physiological principles and time constant assessment.
* **Evaluation Criteria**:
  + Accuracy in identifying the type of respiratory load.
  + Appropriateness of ventilator setting adjustments.
  + Quality and depth of the rationale provided.

### 2. Evaluation of Patient-Ventilator Interactions (PVI)

**Assessment Example: Ventilator Waveform Interpretation Quiz**

* **Description**: Use simulated or patient ventilator waveforms displaying various forms of patient-ventilator discordance (e.g., late cycle, double trigger).
* **Simulation Setup:** Slideshow with different patient ventilator interactions or software-based simulator with predefined interactions.
* **Assessment Task**:
  + **Diagnose** the specific type of PVI discordance shown in each waveform.
  + **Propose Solutions**: Suggest interventions to correct the discordance.
  + **Explain Mechanisms**: Describe the underlying physiological mechanisms causing the discordance.
* **Evaluation Criteria**:
  + Correct identification of PVI issues.
  + Effectiveness of proposed solutions.
  + Understanding of physiological mechanisms.

3.Implementation of Lung-Protective Ventilation

**Assessment Example: Simulation-Based ARDS Management Exercise**

* **Description**: Engage learners in a high-fidelity simulation of a patient with Acute Respiratory Distress Syndrome (ARDS).
* **Simulation Setup:** A lung simulator connected to a mechanical ventilator, or a mannequin that allows mechanical ventilation, or a ventilator connected to a lung simulator and concealed by a mannequin.
* **Assessment Task**:
  + **Develop a Ventilation Strategy**: Create a lung-protective ventilation plan, including setting appropriate tidal volumes and pressures.
  + **Monitor Patient Response**: Adjust the plan based on simulated patient feedback (e.g., oxygenation levels, lung compliance).
  + **Balance Objectives**: Demonstrate the ability to improve oxygenation while minimizing the risk of ventilator-induced lung injury.
* **Evaluation Criteria**:
  + Appropriateness of initial ventilator settings.
  + Responsiveness to patient data.
  + Ability to balance oxygenation and lung protection.

## **Psychomotor Objectives**

### 1. Operate Ventilator Platforms

**Assessment Example: Hands-On Ventilator Setup Skill Check**

* **Description**: Provide learners with a specific ventilator model in a lab setting.
* **Simulation Setup:** Mechanical ventilator and a test lung
* **Assessment Task**:
  + **Setup** the ventilator from scratch, including circuit assembly and initial configuration.
  + **Configure Settings**: Input prescribed ventilator settings accurately.
  + **Demonstrate Alarms**: Show how to set and adjust alarm parameters.
* **Evaluation Criteria**:
  + Correct assembly and setup of the ventilator.
  + Accuracy in entering ventilator settings.
  + Proficiency in managing alarm systems.

### 2. Interpret Ventilator Waveforms

**Assessment Example: Real-Time Waveform Analysis Workshop**

* **Description**: Use a ventilator connected to a lung simulator that can alter lung mechanics dynamically.
* **Simulation Setup:** software-based simulator or programable lung simulator with predefined interactions.
* **Assessment Task**:
  + **Observe** changes in ventilator waveforms as the simulator adjusts resistance, compliance and patient effort (Pmus).
  + based on observed waveform changes to optimize patient care.
  + **Identify Abnormalities**: Recognize patterns indicating issues like air trapping or patient discordance.
  + **Document Findings**: Record observations and suggest potential interventions.
* **Evaluation Criteria**:
  + Ability to accurately interpret waveform changes.
  + Correct identification of underlying issues.
  + Appropriateness of suggested interventions.

### 3. Manage Ventilator Settings in Real Time

**Assessment Example: Time-Limited Ventilator Adjustment Scenario**

* **Description**: In a high-fidelity simulation, learners manage a patient's ventilation as clinical parameters change.
* **Simulation Setup:** Mannequin or programable lung simulator with predefined interactions.
* **Assessment Task**:
  + **Adjust Settings**: Respond to changes in simulated patient status (e.g., rising CO2 levels, decreasing oxygen saturation) by adjusting ventilator settings.
  + **Monitor Effects**: Observe and interpret the immediate impact on gas exchange and lung mechanics.
  + **Communicate Actions**: Explain adjustments to a supervisor or team members in real time.
* **Evaluation Criteria**:
  + Speed and accuracy of ventilator adjustments.
  + Understanding of how changes affect patient physiology.
  + Clarity and professionalism in communication.

## **Affective Objectives**

### 1. Fostering Multidisciplinary Collaboration

**Assessment Example: Interprofessional Team Simulation**

* **Description**: Conduct a simulated emergency scenario (e.g., severe asthma exacerbation) requiring collaboration among physicians, nurses, respiratory therapists, and pharmacists.
* **Assessment Task**:
  + **Coordinate Care**: Work as a team to develop and implement a treatment plan.
  + **Communicate Effectively**: Use clear and respectful communication, demonstrating active listening and appropriate delegation.
  + **Reflect on Team Dynamics**: Participate in a debriefing session to discuss team performance and areas for improvement.
* **Evaluation Criteria**:
  + Effectiveness of teamwork and collaboration.
  + Quality of communication among team members.
  + Insightfulness during debriefing and willingness to improve.

### 2. Empathy for Ventilated Patients

**Assessment Example: Patient Experience Simulation**

* **Description**: Use a simulation where learners experience mechanical ventilation from a patient's perspective (e.g., via virtual reality or by simulating resistance to breathing).
* **Assessment Task**:
  + **Reflect on Experience**: Write a reflective essay or participate in a group discussion about how it felt to be on a ventilator.
  + **Apply Insights**: Propose ways to improve patient comfort and care based on the experience.
  + **Demonstrate Empathy**: Show understanding of the emotional and psychological impact on patients.
* **Evaluation Criteria**:
  + Depth of reflection and personal insights.
  + Practicality and compassion in proposed patient care improvements.
  + Demonstrated empathy and emotional intelligence.

## **Structured Debriefing Sessions for Mechanical Ventilation (MV) Scenarios**

Debriefing is a critical component of simulation-based training, especially in mechanical ventilation (MV), allowing learners to reflect on their performance and identify areas for improvement. Instructors trained in facilitation and debriefing are essential to guide learners through key aspects of the learning process. Debriefing in simulation-based mechanical ventilation education should follow a structured approach that allows learners to reflect on their actions, analyze their decision-making, and connect these insights to clinical practice. There are many debriefing structures and models. Below is an example of how structured debriefing can be applied in MV scenario using a model with 3 phases: **Reaction**, **Analysis**, and **Summary/Reflection:**

1. **Reaction Phase** (Immediate Emotional Response):  
   In this phase, the facilitator allows learners to express their immediate reactions to the simulation experience. The goal is to create a psychologically safe space where learners can share their emotional responses before diving into deeper analysis.
   * **Facilitator Question**:
     + How did you feel during the simulation, particularly when managing the ventilator?

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1. **Analysis Phase** (Deep Reflection and Problem Solving):  
   This is the heart of the debrief, where the facilitator guides learners in analyzing their clinical decisions and technical performance, such as their approach to patient-ventilator management, waveform interpretation, and team communication.

**Technical Reflection**:

* + Learners explain their clinical reasoning behind ventilator settings and how they responded to clinical changes like rising plateau pressures or patient-ventilator asynchrony.
  + **Facilitator Questions**:
    - Why did you choose those initial ventilator settings, and how did they evolve during the scenario?
    - What data did you use to assess patient-ventilator interaction, and how did you adjust the settings in response?
    - What indicators did you use to assess patient-ventilator discordance, and how did you resolve it?

**Self-Assessment and Peer Feedback**:

* + Learners evaluate their own performance and provide constructive feedback to peers. The facilitator helps guide this process by prompting learners to reflect on their decision-making and teamwork.
  + **Facilitator Questions**:
    - Looking back, is there anything you would do differently when managing the patient-ventilator discordance?
    - Can you point out a moment where your peer made a strong decision or where improvement was needed?

**Non-Technical Skills (Teamwork and Communication)**:

* + Reflect on teamwork and communication, focusing on how well the team coordinated actions and shared critical information.
  + **Facilitator Question**:
    - How effectively did the team communicate ventilator changes, and how could collaboration be improved during high-stress moments?

1. **Summary and Reflection Phase** (Key Takeaways and Future Application):  
   In the final phase, learners summarize their key takeaways from the session and discuss how they will apply what they’ve learned to future clinical practice. This phase reinforces learning objectives and encourages learners to integrate lessons into their professional development.
   * **Facilitator Question**:
     + What is the most important thing you learned from this simulation, and how will you apply it in future mechanical ventilation scenarios?
   * **Reflection Prompts**:
     + What aspects of your decision-making would you improve upon for next time?
     + How will you adjust your communication style when working with multidisciplinary teams in the future?

## **Examples of Assessment for mechanical ventilation**

### Formative Assessments in Mechanical Ventilation

* **Purpose**: To provide ongoing feedback during mechanical ventilation simulations and allow learners to refine their technical and cognitive skills.
* **Examples**:
  + **Real-Time Coaching**: During a simulation where learners manage a ventilated patient with worsening ARDS, the facilitator provides immediate feedback on ventilator adjustments. For example, if a learner increases tidal volume inappropriately, the facilitator might step in and prompt the learner to reconsider lung-protective strategies based on the clinical situation.
  + **Immediate Post-Simulation Feedback**: After a simulation involving ventilator waveform interpretation, learners receive direct feedback on their ability to identify issues such as auto-PEEP or double triggering. Feedback may focus on improving the speed of adjustments or ensuring better synchrony with the patient’s efforts.

### Summative Assessments in Mechanical Ventilation

* **Purpose**: To evaluate learner competence after completing simulation-based training in mechanical ventilation.
* **Examples**:
  + **Objective Structured Clinical Examinations (OSCEs)**: Learners participate in an OSCE where they are tasked with managing a simulated patient in respiratory failure. They must:
    - Select appropriate initial ventilator settings based on patient presentation (e.g., a patient with ARDS vs. COPD).
    - Identify and correct issues with patient-ventilator interactions, such as triggering issues or over-assistance.
    - Adjust ventilator settings in response to changes in the patient’s condition, such as rising CO₂ levels or hypoxemia.
  + **Competency Checklists**: Instructors assess learners using detailed checklists. For example, a checklist for an ARDS patient scenario may include:
    - Proper selection of a lung-protective ventilation strategy (tidal volume < 6 ml/kg ideal body weight).
    - Appropriate adjustment of PEEP and FiO₂ based on the local protocol.
    - Timely identification and correction of patient-ventilator discordance.